IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant	:	Chieh Ou-Yang	Confirmation No. 3335
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Docket No.	:	35194US1	

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REPLY BRIEF (37 CFR §41.41)

On December 17, 2008, Applicant filed a First Supplemental Appeal Brief. On March 3, 2009, the USPTO issued the Examiner's Answer. The period to respond to the Examiner's Answer is set to expire May 3, 2009. This Reply Brief is timely filed before that date.

Response to Examiner's Arguments Regarding 102/103 Rejection of Claim 1 Over Shirley

At pp. 4-6 of Examiner's Answer, the Examiner states that Shirley teaches that the bowl temperature controller 50b can include a source of heated or cooled gas above the substrate because that reference teaches that "the bowl temperature controller 50b can include a plurality of heat exchangers 52b and manifolds 54b, arranged in a manner generally similar to that discussed above with reference to the plate temperature controller 50a." The Examiner's opinion is that "arranged in a manner" refers not only to the way in which a *plurality* of heat exchangers/manifolds 502b/54b could be arranged, as opposed to *only one* of each, but also to the location where such an arrangement may be placed. Later, the Examiner stated:

> [I]t is the Examiner's position that the cited section [quoted above] indicates that any of the discussed features of the plate temperature

> controller 50a, including the <u>location</u> of the manifold, orifices, etc., may be incorporated into the bowl temperature controller 50b.

Examiner's Answer at 11 (emphasis added).

Respectfully, this is simply not the right conclusion to be drawn from Shirley after reading that entire reference carefully, and as a whole. Shirley describes the chill plate assembly 20 (including plate temperature controller 50a) and coater bowl assembly 30 (including bowl temperature controller 50b) separately, beginning with the former.

The chill plate assembly 20 is described at col. 3, line 25 to col. 4, line 27. There it is explained that a fluid supply 51a is coupled via conduits 53a to manifolds 54a, wherein each manifold 54a can have a nozzle with an orifice 55a facing the substrate. (Col. 3, lines 31-35). Then it is explained that the fluid supply 51a can be coupled to a plurality of heat exchangers 52a, each being "individually controllable to direct fluid at different temperatures to each manifold 54a." (Col. 3, lines 47-52).

Subsequently the coater bowl assembly 30 is described at col. 4, line 43 to col. 5, line 14. Because it is critical to the disposition of this appeal, the description of the bowl temperature controller 50b is reproduced in its entirety below:

> The bowl temperature controller 50b is coupled to the coater bowl assembly 30 to transfer heat to or away from the substrate 70 as the substrate 70 rotates relative to the coater bowl 31. In one embodiment, the temperature controller 50b includes a fluid supply 51b coupled to a <u>*single heat exchanger 52b which is in turn coupled with a conduit 53b to a single manifold 54b*</u>. The manifold 54b includes a plurality of orifices 55b disposed in a concentric, annular arrangement about the rotatable chuck 32 to transfer heat to or from the substrate 70.
>
> The <u>*heat transferred to or from the substrate 70 can be controlled by adjusting the flow rate through each of the orifices 55b*</u>. For example, the orifices 55b toward the periphery of the substrate 70 can be smaller than those toward the center of the substrate 70 to reduce the rate of heat transfer to or from the periphery of the substrate 70. Alternatively, each of the orifices 55a can have a variable diameter that can be adjusted manually or via an actuator to direct the flow at a selected flow rate through each orifice 55a. <u>*In another embodiment, the bowl temperature controller 50b can include a plurality of heat exchangers 52b and manifolds 54b, arranged in a manner generally similar to that discussed above with reference to the plate temperature controller 50a*</u>.
>
> In one embodiment, the coater bowl assembly 30 can also include one or more <u>*temperature sensors positioned proximate to the front side 72*</u>

> *of the substrate 70 to detect one or more temperatures of the substrate 70*. For example, as shown in FIG. 1, the coater bowl assembly 30 can include a peripheral temperature sensor 60a aligned with the peripheral region of the substrate 70 and a central temperature sensor 60b aligned with the central region of the substrate. In one embodiment, the temperature sensors 60a, 60b can include infrared sensors and in other embodiments, the temperature sensors can include other suitable devices. The temperature sensors 60a, 60b can be coupled to the bowl temperature controller 50b to provide a temperature feedback loop. Accordingly, the bowl temperature controller 50b can receive signals from the temperature sensors 60a, 60b and adjust the heat transfer rate to and/or from the substrate 70 to achieve a desired temperature distribution on the front side 72 of the substrate 70.

Shirley, col. 4, line 58 to col. 5, line 14 (emphasis added).

With reference to the emphasized portions above, two embodiments of the bowl temperature controller 50b are described. In the first, a single heat exchanger 52b is coupled to a single manifold 54b to direct a heat transfer fluid to the backside of the substrate (as shown in the left side of Fig. 1). In this first embodiment, differential temperature control of the substrate can be achieved by "controlling or adjusting the flow rate through" different orifices 55b of the single manifold at different annular locations. *See* passage quoted above in conjunction with Fig. 1. The quoted passage goes on to explain that variable flow rates can be achieved by giving different orifices 55b different-sized openings (e.g. smaller orifices at periphery of the substrate as explained above). Alternatively, each of the orifices 55b can have an adjustable diameter that can be adjusted manually or via an actuator. *See* quoted passage above. Regardless which of these two alternatives (different-sized orifice openings or variable orifice openings) is used, differential temperature control across the substrate is achieved via a common fluid (i.e. at the same temperature) flowing through the single manifold. A relatively warmer temperature would be achieved by delivering a greater flow rate of that fluid to one location, whereas a relatively colder temperature would be achieved by delivering a lesser flow rate to another location (assuming a hot fluid).

Immediately thereafter (beginning at col. 5, line 10), a second embodiment is disclosed as an alternative to the one just described. In this second embodiment, instead of using a single fluid and varying the flow rate through different nozzles of the single manifold, "the bowl temperature controller 50b can include a plurality of heat

exchanger 52b and manifolds 54b, arranged in a manner generally similar to that discussed above with reference to the plate temperature controller 50a." Col. 5, lines 10-14, and also quoted above (emphasis added).

It could not be clearer that all this passage is saying is that instead of using a single manifold with variable nozzle openings, one can use a plurality of different manifolds to deliver different-temperature fluid at different locations, as was described previously for the plate temperature controller 50a. The phrase, "arranged in a manner generally similar to [the plate temperature controller 50a]," simply means that the plurality of manifolds and heat exchangers can be used and connected to one another in similar fashion. In other words, like the plate temperature controller, the bowl temperature controller also can have a fluid supply (*cf.* 51a) coupled via conduit**s** (*cf.* 53a) and a plurality of separate heat exchanger**s** (*cf.* 52a) to separate manifold**s** (*cf.* 54a), wherein each manifold has its own nozzle with an orifice (cf. 55a) facing the substrate, and wherein each heat exchanger (*cf.* 52a) is "individually controllable to direct fluid at different temperatures to each manifold [*cf.*] 54a." (*Cf.* col. 3, lines 31-35 and 47-52, referenced above).

There is no indication that the location of the bowl temperature controller can be changed to place it above the substrate. In fact, every indication is to the contrary. In addition to those indications mentioned in the appeal brief, it is further noted that immediately following the description of the bowl temperature controller 50b, it is explained that temperature sensors can be "positioned proximate to the front side 72 of the substrate 70 to detect one or more temperatures of the substrate 70." *See* col. 5, lines 15-32, the last quoted paragraph above. Here, infrared or other sensors can be used to detect the surface temperature at the front side 72 of the substrate. The presence and impingement of heat-transfer fluid on the front surface 72 would interfere with or skew accurate temperature measurement at that surface. So not only does Shirley clearly not instruct the skilled artisan to position the bowl temperature controller at the front side 72, this is yet another reason why Shirley suggests that should not be done (in addition to those already given in the Appeal Brief).

As seen above, the plain disclosure of Shirley contradicts the Examiner's view that not only the arrangement, but the location of the bowl temperature controller 50b

can be borrowed from the plate temperature controller 50a. Shirley does not disclose positioning the bowl temperature controller 50b above the substrate similar to the present claims. Accordingly, Shirley does not anticipate those claims.

Shirley also does not render those claims obvious for the reasons given in the Appeal Brief. The Examiner's Answer espouses the Examiner's view that a skilled engineer could determine an appropriate configuration such that jets of temperature-control fluid could be located above the substrate in the coater bowl assembly 30 instead of below it. Examiner's Answer at 12. This argument continues to ignore the fact that whether one could make the proposed modification is not a proper test for invention or non-obviousness. Indeed, all inventions could be made; this is obviously so because in each case the inventor does make it. If 'could be made' were the test, then all inventions would be obvious and there would be no patents.

Rather, the appropriate query is would a person of ordinary skill in the art have been motivated to make the proposed modification. Underlying this inquiry is whether such a person would have had a reasonable expectation of success. Although the Examiner briefly addresses this argument on page 12 of the Examiner's Answer, she does not do so adequately to sustain the rejection. Instead, she simply

> maintains that one having ordinary skill in the art would have recognized that both Shirley's chill plate and coater assemblies have similar structures, effects, and purposes – to similarly provide heating or cooling to selected areas of a substrate to provide a temperature gradient on the substrate, and that it would have been obvious to have incorporated one of the features of the chill plate temperature controller, such as its location above the substrate instead of below it, into the coater bowl temperature controller with the expectation of similar and successful results.

Examiner's Answer at 12.

Respectfully, the Examiner's reasoning is entirely conclusory and without support. It fails to recognize that the purpose of the chill plate and coater bowl assemblies are not the same; in fact it incorrectly states the opposite. The purpose of the chill plate assembly is to regulate the substrate temperature between an earlier operation and a subsequent coating operation, or to "compensate in advance for a subsequent non-uniform heat transfer process [in the coater bowl assembly]." Shirley, col. 1, lines 27-28 and 61-65. Nothing else is going on in the chill plate assembly 20 of

Shirley; no coating is being applied or other operation being carried out on the substrate that could be interfered with in that assembly 20. Conversely, in the coater bowl assembly 30 a coating is applied to the front surface 72. Application of direct temperature control at that surface (particularly via impingement of a fluid different from that being applied) may interfere with the coating application. In addition, such may affect or impede direct and accurate temperature measurement of the surface 72, for example via infrared detection. The Examiner actually acknowledges these points in the Examiner's Answer at p. 13. Then, without otherwise addressing or refuting them, in the very next sentence she simply "maintains the position that it would have been obvious...to have incorporated the optional placement of the temperature controller for the coater bowl assembly above the substrate...with the expectation of successful results." Examiner's Answer at 13. This conclusory statement does not track with the preceding acknowledgment that doing what the Examiner describes could damage components or features on the front side 72 of the substrate, particularly while a coating is being applied to that surface as in the coater bowl assembly 30.[1]

For these reasons Shirley did not apply temperature control to the front surface 72 of the substrate in the coater bowl assembly 30. For the same reasons, it would not have been obvious to do so. Could a skilled engineer devise a way to do so? The answer is yes. The present applicants have done it by ignoring the conventional wisdom, which is to require backside temperature control while spin-coating on a substrate as evidenced by both Shirley and Kim. But "could" is not the measure of obviousness. The correct measure is whether one would have been motivated to modify the references based on one's knowledge of the art and what the references

[1] The Examiner further states: "It is further the Examiner's position that it would have been within the skill of an ordinary artisan to have monitored the heating/cooling and the state of the liquid applied on the substrate and selected appropriate levels of heating/cooling to be used such that no damage was done to the applied liquid coating." Examiner's Answer at 13. No basis for this conclusory statement is given. For example, is the damage that may be done based on the temperature of the fluid? Its pressure or flow rate? All three? Does the fluid chemically change the coating, or simply make it non-smooth? How would these factors interplay so that accurate gradient temperature control can be achieved while avoiding undesirable effects in the applied coating liquid, the spreading of that liquid, the coating once dry, or other features of the front surface 72 itself? None of these questions is addressed aside from the Examiner's conclusory statement that a "skilled artisan" would know how to balance all the competing factors so "no damage was done." Shirley contradicts this argument when it explains that backside temperature control is preferred even in the chill plate assembly 20, where no coating is applied, to avoid front-side damage. From this, it certainly was not obvious to use front-side temperature control in the

teach.

A person of ordinary skill in the art cannot be expected to ignore conventional wisdom and act in contravention of reference teachings. The Examiner's conclusory argument essentially is that it would have been obvious to modify the bowl temperature controller 30 by selecting any feature of the plate temperature controller 20 (including its location) because, in her view, both have the same purpose – to heat or cool the substrate. But while heat may be supplied in both devices, they do not have the same purpose as explained above. Their different purposes and functions cannot be ignored when deciding which features to pick and choose, in hindsight, from one to modify the other.

Finally, the Examiner noted that "*KSR* forecloses the argument that a **specific** teaching, suggestion, or motivation is required to support a finding of obviousness." Examiner's Answer at 12 (emphasis original). The applicants do not dispute this statement of the law. Rather they dispute that *any* appropriate suggestion or motivation has been identified to modify the bowl temperature controller 50b as the Examiner suggests. The applicants further submit that Shirley teaches away from doing so for all the reasons explained above and in the Appeal Brief. Accordingly, it is respectfully submitted that the rejections of Shirley are improper and should be reversed.

Response to Examiner's Arguments Regarding 103 Rejection of Claim 1 Over Kim in view of Thakur

The Examiner argued that Kim is relied upon to disclose providing a temperature gradient to a substrate, and that Thakur is cited "merely for its teaching that heat may be generated on a coated substrate by the use of radiation supplied from above the substrate, instead of from below the substrate." Examiner's Answer at 14. The problem with this argument is that Kim and Thakur apply a coating to a substrate in different ways that will be affected differently based on how thermal energy is applied. In Kim, the coating is applied as a liquid similar as in Shirley. For this reason, similar considerations apply in Shirley as apply in Kim, which, predictably, achieves temperature control from underneath. Conversely, in Thakur atomized droplets are

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coater bowl assembly 30 where a coating is being applied.

dispersed over the substrate surface and then thermal energy is applied to vaporize the solvent in the droplets, leaving behind the non-volatile components to form the coating. There is no liquid-phase spreading[2], and no bulk liquid-layer application to the substrate surface. Hence, none of the considerations that militate against direct temperature control of the upper substrate surface in Kim (or Shirley) applies in Thakur. In fact, unlike Kim, in Thakur it is desirable to directly radiate the atomized droplets so their volatiles will vaporize more readily. It is improper to suggest that Thakur can be used to modify Kim simply because in Thakur lamps are positioned above the substrate rather than below it. This completely ignores the reasons that Kim does not do this.

The Examiner also argues that Thakur discloses providing a precise temperature gradient in the substrate because in Thakur "'the energy emitted by the lamps can be easily and precisely controlled and varied' and that light energy can be instantaneously increased." Examiner's Answer at 14. The Examiner then suggests it would have been obvious to look to Thakur to provide a precise temperature gradient because "Kim et al. suggests…to look to the prior art for other means of using electromagnetic waves/radiation to supply heat to a coated substrate, particularly to form a temperature gradient on the coated substrate." *Id.* at 15.

Respectfully, Kim states simply that "it is possible to use other electromagnetic waves" besides infrared waves, as the Examiner has correctly quoted. *Id.* This does not explain, however, how Thakur's lamps (a totally different type of emitter compared to an infrared generator 51 coupled to optical cables 52 that precisely target portions of the substrate in Kim) will achieve a precise temperature gradient. As noted above, the Examiner points to statements in Thakur that the lamp intensity can be controlled. But in Thakur there is no way to control the <u>focus</u> of the energy coming from those lamps. Light and thermal energy emitted from a point source such as a lamp will simply scatter

[2] At p. 8 of the Examiner's Answer it says that Thakur teaches distributing a viscous liquid over a surface of a substrate by a spin coating process (citing col. 7, lines 45-47). This is misleading. In Thakur, there is no spreading of a liquid coating that is dried by Thakur's lamps (*see* col. 2, line 57 to col. 3, line 11, which distinguish spin-coating techniques as inferior). Instead the lamps are used to vaporize the solvent from atomized droplets dispersed over the substrate surface to apply the inventive coating. While spin coating is mentioned in Thakur, it is only to apply a separate layer above or below the inventive coating (which is the subject of Thaker). *See* col. 6, lines 33-50, which state that conventional spin-coating techniques can be used to apply additional layers over or under the inventive layer in Thakur. No explanation of such "conventional" techniques is given for these other layers. It is submitted that such "conventional" techniques are those described in Shirley and Kim, both employing backside temperature control.

if not otherwise precisely focused. In Kim, optical cable 52 is used to direct and focus the IR radiation to precise locations over the substrate to produce a controlled gradient. Such focus is not at all achieved in Thakur. Regulating the <u>intensity or power</u> of Thakur's lamps has nothing to do with their focus. Moreover, in Thakur no precision focus is required <u>or even possible</u>, because there the whole point is to uniformly radiate atomized droplets dispersed over the entire substrate surface. A focused application of radiation would radiate only a small proportion of the droplets, and would not achieve uniform irradiation. This is a further demonstration of the entirely incongruent uses, and functions, of different types of radiation in Kim and Thakur.

The fact that Thakur's lamps may incidentally affect the substrate temperature, Examiner's Answer, bottom of p. 15) is irrelevant. No precise gradient control is achieved. Nor is such precise control possible using Thakur's lamps. Thakur certainly cannot suggest relocating Kim's IR imitter and optical cables 52 above the substrate instead of below. The two are entirely different processes that have nothing in common, including the function and uses of thermal energy emitted from the respective infrared generator in Kim and lamps in Thakur.

To further demonstrate this point, Thakur explains at col. 9, lines 52-60 that, "[i]t should be understood…that photoresist coatings made according to the present invention need not be baked after being deposited onto a semiconductor wafer as is necessary in many conventional techniques such as spin coating techniques. In particular, the process of the present invention is more efficient than prior art processes in removing unwanted solvents in the deposition process, eliminating the need to later bake the coatings." Thus, Thakur clearly is not a spin-coating process, as is Kim. Thakur certainly does not instruct a skilled artisan to modify Kim's process to achieve heating from above. In Kim, heating is used to regulate the spreading and ultimately drying of the applied liquid coating. Thakur has nothing to do with such a coating, is not a spin-coating process and does not reasonably suggest modifications to such a process. Spin coating is unrelated to (and in fact expressly distinguished from, Thakur's process. The same concerns and reasons surrounding the application of heat do not apply.

For these reasons, the rejections based on Kim in view of Thakur remain

improper and should be reversed.

Conclusion

In view of the foregoing, it is respectfully submitted that the rejections of claim 1 remain improper and should be reversed. All remaining claims depend from claim 1. Accordingly, the rejections of these claims should be reversed, as well. If any fees are required by this Reply Brief, please charge any and all such fees to our Deposit Account No. 16-0820, Order No. VOSS-35194US1.

Respectfully submitted,
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